To re-tune or not to re-tune

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All models of lexical selection must specify a selection mechanism or criterion, namely the condition that must be satisfied before a single lexical item is selected for production. In Weaver++ (Roelofs, 1992), the selection criterion is competitive, in that the time required to select the target depends on the activation of other representations. Other models use a time-restricted selection criterion, where at some time point *t*, the representation with the highest activation level will be selected (Dell, 1986). This selection criterion is non-competitive, in that the relative activation levels of the non-selected representations have little impact on the outcome of the process. Building on the insights from Signal Detection Theory, Nozari and Hepner (NH hereafter) argue for a flexible selection criterion, where the activation differential between the highest activated lemma and its nearest competitor, e.g., the conflict, modulates depending on task goals, impairments, etc. By allowing the criterion to vary, NH argue that they can explain both competitive and non-competitive-like behaviours.

In this commentary, we explore whether and to what extend the impact of the flexible criterion can be distinguished from the fluctuations of the semantic-lexical mapping, which may also be sensitive to task goals. If the criterion and the distribution of conflict are both sensitive to task goals, we fail to see how they can be viewed as independent. Under the view that these two components may not be independent, we explore the explanatory value the flexible criterion brings to the study of neurotypical speakers and ask for clarity regarding the circumstances under which the criterion will be adjusted. Finally, we discuss the specific operationalization of conflict in light of our own past research.

NH's proposal rests on the idea that the response criterion can be flexibly re-tuned to optimize performance, prioritizing speed or accuracy. Task goals are one factor that

influence the criterion. The criterion is assessed against the relative activation levels of the target and its nearest competitor, deriving a measure of the conflict. The perspective that lexical selection is influenced by two independent components, activation spread which determines conflict and a flexible selection criterion that is sensitive to task goals, offers a highly interesting perspective on lexical-semantic processing. However, while theoretically the criterion and conflict should vary independently of each other, in reality this may not always be the case. The key point is that task goals, which influence the criterion, may also influence the semantic-lexical mapping, which in turn determines the amount of conflict. For example, an instruction (task goal) to name objects with the actions they perform (e.g., name the picture of a broom with the verb 'to sweep') may lead to an adjustment of the criterion, possibly prioritizing accuracy, but will also impact the manner in which information across the semantic network spreads. This modulation of semantic activation will determine the distribution of conflict. Hence, conflict and the criterion may be affected by the same factor in this example.

If task goals can influence the distribution of conflict (via the semantic-lexical mapping), then when is the flexible criterion required? NH make clear that the flexible criterion is not needed to explain many semantic context effects, discussing findings from blocked cyclic and continuous naming paradigms. We concur and have long argued that the dynamics of the semantic-lexical mapping, combined with a competitive selection mechanism, explain many observations critical to the debate surrounding the competitive nature of the selection mechanism. For example, the contrasting effects of associative vs. categorical semantic relations in the PWI paradigm has been widely cited as problematic for models adopting a competitive selection mechanism. But, Abdel Rahman and Melinger (2009)

argued that the representational differences between categorical and associative semantic relations give rise to fundamentally different patterns of semantic activation, directly impacting the conflict and hence naming times. Furthermore, they demonstrated that task demands could modulate this mapping by making a semantic context more or less salient. Specifically, when a set of inter-connected pictures was presented, as in the blocked cyclic and continuous naming tasks, they observed an associative inference effect; but, when the same stimuli were presented as pairs of related concepts in the PWI paradigm, no interference was observed (Abdel Rahman & Melinger, 2007; Rose & Abdel Rahman, 2016). Hence, we agree with NH that a host of behavioural results from neurotypical speakers can be explained without reference to a flexible criterion.

In fact, it is unclear to us which results from neurotypical participants rely on the flexible criterion for explanation. The main example cited by NH refers to contrasting results from free naming (Oppenheim, 2017) compared to prescribed naming (Alario et al, 2004). NH argue that prescribing a label changes the task goal and shifts the criterion to prioritize accuracy, resulting in more evidence of interference. However, broader inspection of the literature reveals that many studies have reported interference effects in free naming tasks (e.g., Belke & Stielow, 2013; Howard et al, 2006; Schnur, 2014; Vitkovitch & Tyrrell, 1995) and these are not obviously different from the interference effects obtained when labels are prescribed. It is therefore unclear what factor underlies the differences between Alario et al and Oppenheim, but it is unlikely to be the naming instruction.

In a study by Aristei and Abdel Rahman (2013), task goals were similarly manipulated by allowing participants either to name pictures freely or only under specific conditions. In a PWI task, target pictures (e.g., a dolphin) were presented with to be ignored distractor

words that were categorically related (e.g., horse) or unrelated (house). Participants either named all pictures or a subset that satisfied a specific rule (e.g., name only objects that can be found in the water). This manipulation of the task goal should prioritize response accuracy in the conditional naming compared to the free naming condition and should therefore directly affect the criterion. However, the behavioural interference observed in the two naming conditions was similar, suggesting that this direct manipulation of the task goals was insufficiently potent to adjust the selection criterion.

Thus, while the flexible criterion may be highly relevant in extreme cases, such as for patients with language impairments, it is as yet unclear under what circumstances the selection criterion is adjusted in less extreme cases. A model of lexical-semantic processing should account for both semantic interference and facilitation effects, as both are central to a comprehensive understanding of language production. If the criterion is only re-tuned in extreme cases, it is unclear how this model would capture facilitation, raising question about how much explanatory power the flexible criterion brings to the study of the neurotypical production system. Furthermore, the dynamic nature of the semantic-lexical mapping allows for task goals to impact processing at multiple levels, making it very difficult to distinguish the unique contribution of the criterion.

Our final point relates to the operationalization of conflict. NH define conflict in terms of the strongest competitor only. Although NH do not take a strong position on this point, they note that their previous modelling supported this formulation. In our past work (Abdel Rahman & Melinger, 2009), we have advocated for a selection mechanism that considers network-wide activation. Indeed, our Swinging Lexical Network proposal depends upon it,

assuming co-activation via semantic relations within cohorts and taking activation levels of cohorts into account.

Several findings support the assumption that more than one competitor contributes to the conflict calculation. For instance, Abdel Rahman and Melinger (2008) found that presenting two different categorically related distractor words (e.g., presenting ‘camel’ and ‘sheep’ for the picture *elephant*) slows picture naming more than presenting only a single categorically related distractor (e.g., only ‘camel’). Rabovsky, Schad, and Abdel Rahman (2016) observed that picture naming times were slowed by an increasing number of semantic neighbors of a concept (see also Mirman, 2011; Fieder et al., 2018 These results are easily explained if the activation level of the entire network contributes to the calculation of conflict.

Can such findings also be explained by modulations of the semantic-lexical mapping, which seems to be the natural locus of explanation within NH’s model? Certainly, many interrelated competitors will mutually-enhance activation levels of each cohort member. Hence, more conflict might be generated even under the single competitor formulation. However, the interrelated active competitors do not only strengthen one another — they also strengthen the target. With both the competitor and the target’s activation levels increased, it is unclear how much the distribution of the conflict will actually change under the single competitor formulation. In contrast, if all strongly activated competitors directly contribute to the calculation of conflict, the observed increase in competition is clearly explained.

The above arguments notwithstanding, at the end of the day, we do not yet have sufficient evidence to definitely choose one definition of conflict over another. Further research is

needed to determine whether both the number AND strength of competitors is relevant to lexical selection times, in line with our previous proposals, or whether consideration of the most active competitor suffices, as suggested by NH.

Conclusion

NH outlined an interesting theory building on a signal-detection framework. We find the basic tenant of the proposal, namely that the selection criterion is flexible, intuitive. However, we remain unclear on how it applies for unimpaired speakers. We acknowledge that the selection criterion may vary between different speakers — one speaker may be more conservative and focus on accuracy, while another may prioritize speed at the cost of producing more errors — but the relevance for within-speaker variations is less clear. We look forward to the future development of the proposal, including additional modelling and experimentation to fully understand the independent explanatory contributions of the semantic-lexical mapping vs. the flexible criterion and the conditions that would trigger a criterion change.

References

Abdel Rahman, R., & Melinger, A. (2007). When bees hamper the production of honey: Lexical interference from associates in speech production. *Journal of Experimental Psychology: Learning, Memory and Cognition, 33*(3), 604-614.

Abdel Rahman, R., & Melinger, A. (2008). Enhanced phonological facilitation and traces of concurrent word form activation in speech production: An object naming study with multiple distractors. *Quarterly Journal of Experimental Psychology, 61*, 1410-1440.

Abdel Rahman, R., & Melinger, A. (2009). Semantic context effects in language production: A swinging lexical network proposal and a review. *Language and Cognitive Processes, 24*(5), 713-734.

Aristei, S., & Abdel Rahman, R. (2013). Semantic interference in language production is due to graded similarity, not response relevance. *Acta Psychologica*, *144*(3), 571-582.

Belke, E., & Stielow, A. (2013). Cumulative and non-cumulative semantic interference in object naming: Evidence from blocked and continuous manipulations of semantic context. *The Quarterly Journal of Experimental Psychology*, *66*(11), 2135-2160.

Blanken, G., Dittmann, J., & Wallesch, C.-W. (2002). Parallel or serial activation of word forms in speech production? Neurolinguistic evidence from an aphasic patient. Neuroscience Letters, 325(1), 72–74.

Dell, G. S. (1986). A spreading-activation theory of retrieval in sentence production. Psychological Review, 3, 283-321.

Fieder, N., Krajenbrink, T., Foxe, D., Hodges, J., Piguet, O., & Nickels, L. (2016). Less is more-Effects of semantic neighbourhood on naming in semantic dementia (svPPA). *Stem-, Spraak- en Taalpathologie, 21*, 65-68.

Fieder, N., Wartenburger, I. & Abdel Rahman, R. (2018) Memory & Cognition. https://doi.org/10.3758/s13421-018-0856-y

Howard, D., Nickels, L., Coltheart, M., & Cole-Virtue, J. (2006). Cumulative semantic inhibition in picture naming: Experimental and computational studies. *Cognition*, *100*(3), 464-482.

Mirman, D. (2011). Effects of near and distant semantic neighbors on word production. *Cogn Affect Behav Neurosci, 11*(1), 32-43.

Nozari, N., Dell, G. S., & Schwartz, M. F. (2011). Is comprehension necessary for error detection? A conflict-based account of monitoring in speech production. Cognitive Psychology, 63(1), 1–33.

Rabovsky, M., Schad, D. J., & Abdel Rahman, R. (2016). Language production is facilitated by semantic richness but inhibited by semantic density: Evidence from picture naming. *Cognition*, *146*, 240-244.

Roelofs, A. (1992). A spreading-activation theory of lemma retrieval in speaking. Cognition, 42, 107-142.

Schnur, T. T. (2014). The persistence of cumulative semantic interference during naming. *Journal of Memory and Language*, *75*, 27-44.

Vitkovitch, M., & Tyrrell, L. (1995). Sources of disagreement in object naming. *The Quarterly Journal of Experimental Psychology*, *48*(4), 822-848.